
Space Weather Technical Forecast

Issued on Monday, 01 May 2023 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of R1/R2 throughout. Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M2.4 at 30/2028 UTC from a new region rotating onto the northeast limb. There are six sunspot regions, with the largest AR3288 in the southwest quadrant consisting of a number of mature spots but also with clear delta spots visible. This has been the source of a few C-flares. AR3289 just east of the north-centre disc is also of note, as a small but compact region, although this has seen its previous delta spot now fade. The other regions are smaller and simple. There are a number of potentially eruptive filaments on the Earth-facing disc, however no Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1 was indicative of a waning fast wind influence from CH96/-. The speed declined from strong levels of around 600km/s to be slightly elevated at around 480 km/s. The density was mainly below average. The total IMF, Bt, was weak at below 6nT with the north-south component Bz varying between +4 nT and -4 nT. The phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at background levels throughout. High energy electron flux (greater than 2MeV) as measured at GOES16, has been at mostly High levels, peaking at 7830 pfu at 30/1625 UTC. The 24-hour integrated fluence was at Active, but with a declining trend, with 2.5e8 integrate pfu recorded at 01/0000 UTC.

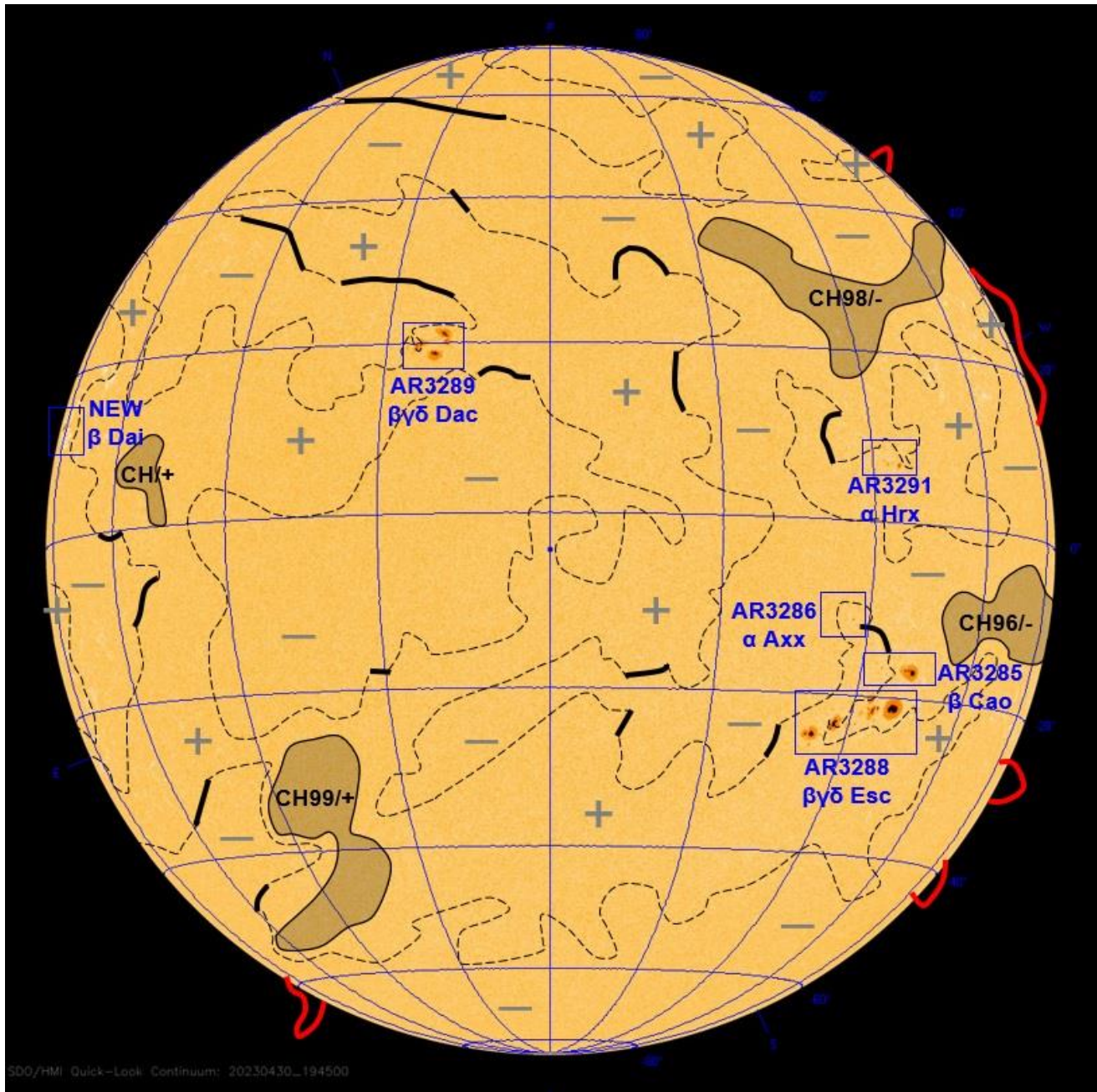
Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of further M-class flares.

Solar Wind / Geomagnetic Activity: There are several CMEs which are expected miss Earth, passing on day 1 and 2 (01 and 02 May), however glancing influences cannot be ruled out. The most likely of these left the Sun on the 29 Apr and is expected to pass late on day 2, with any influence potentially continuing into day 3 (02 and 03 May). Otherwise current fast wind conditions are expected to gradually ease, although some peripheral enhancement is also possible from CH98/- through days 1 and 2 (01 and 02 May). Geomagnetic activity is expected to be Quiet to Unsettled, but with ongoing chance of Active intervals, mainly late day 2 or early day 3 (02 and 03 May), with a slight chance of G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels, but with a slight chance of rising in response to any notable flares, primarily from AR3288. High energy (greater than 2MeV) electron flux is expected persist at mainly High levels, but with peak levels gradually declining. Any CME or CH98/- HSS arrival has the potential to drop out the flux levels, reducing confidence by day 3 and 4 (03 and 04 May). The associated 24 hour Electron fluence is currently above the Active level (1e8 integrated pfu) and expected to persist at this level, albeit with a declining trend, with confidence decreasing by day 3 (03 May).

Figure 1. Solar Analysis Valid 30/2000 UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

There have been numerous mainly faint filament eruptions resulting in observable CMEs over the past few days. These have been assessed as likely missing, however some glancing influences are possible through days 1, 2 and 3 (01-03 May) due to their proximity as they pass Earth. The most likely of these to give any noticeable impact is from a CME which occurred early on 29 Apr from near AR3288. Any interaction from this is likely to be late on day 2 (02 May) as it passes south of Earth, and potentially into day 3 (03 May).

Otherwise, the fast wind from CH96/- is expected to continue easing, with the current slightly elevated speeds declining erratically towards background speeds by the end of day 2 (02 May). This is only moderate confidence, however, as CH98/- in the northern disc may prolong the slightly elevated winds until day 3 (03 May), although any HSS from this feature is currently signalled by enlil to pass largely north of Earth. No other significant enhancements are expected.

Geomagnetic activity is expected to be Quiet to Unsettled, but with ongoing chance of Active intervals from any CME influence, most likely late day 2 or into day 3 (02 or 03 May) with a slight chance of G1 Minor Storm intervals. Any influence from CH98 HSS also brings the chance of isolated Active intervals day 1 or 2 (01 or 02 May).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	15	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/1002	Partial	Filament	S disc nr AR3288	510 km/s	Missing	Chance of glancing impact late 02 May

Figure 2a: Enlil showing arrival missing CME to the south potentially glancing. Various CMEs also visible in ensemble below.

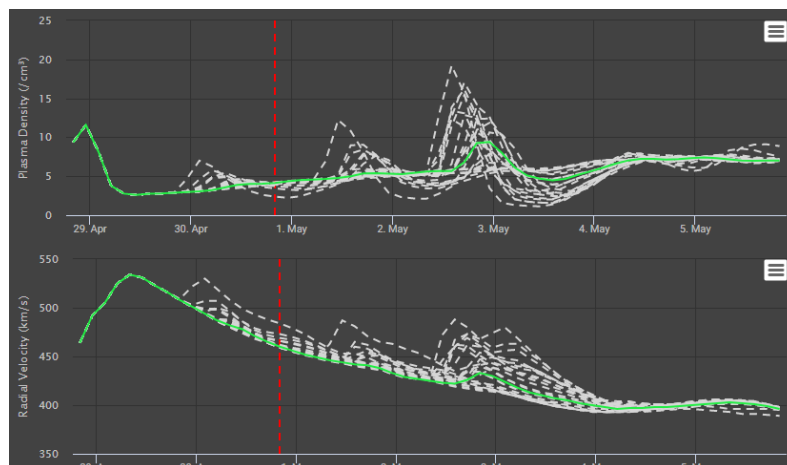
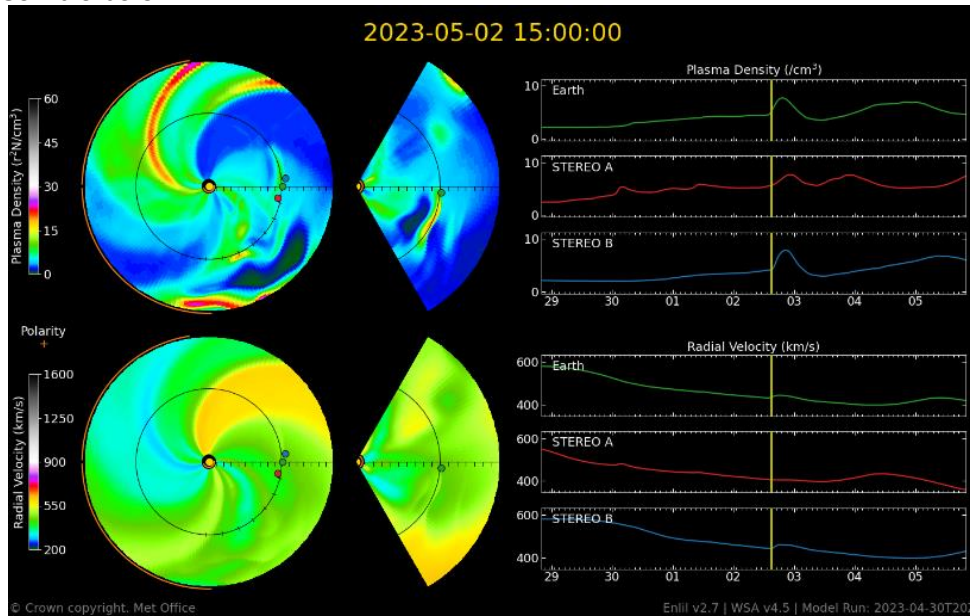
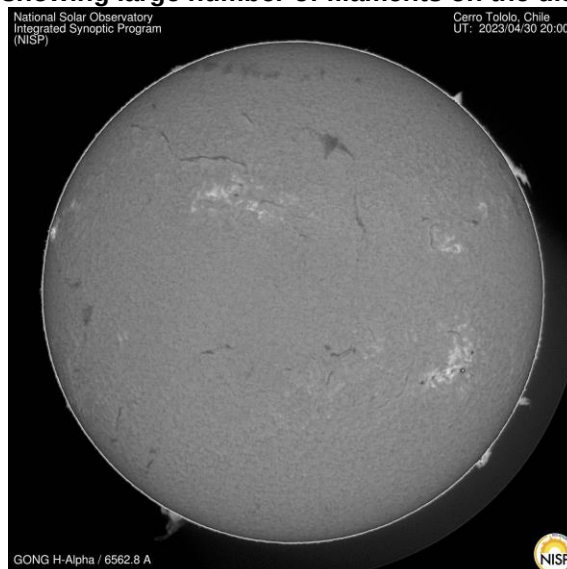


Figure 2b: H-alpha imagery showing large number of filaments on the disc



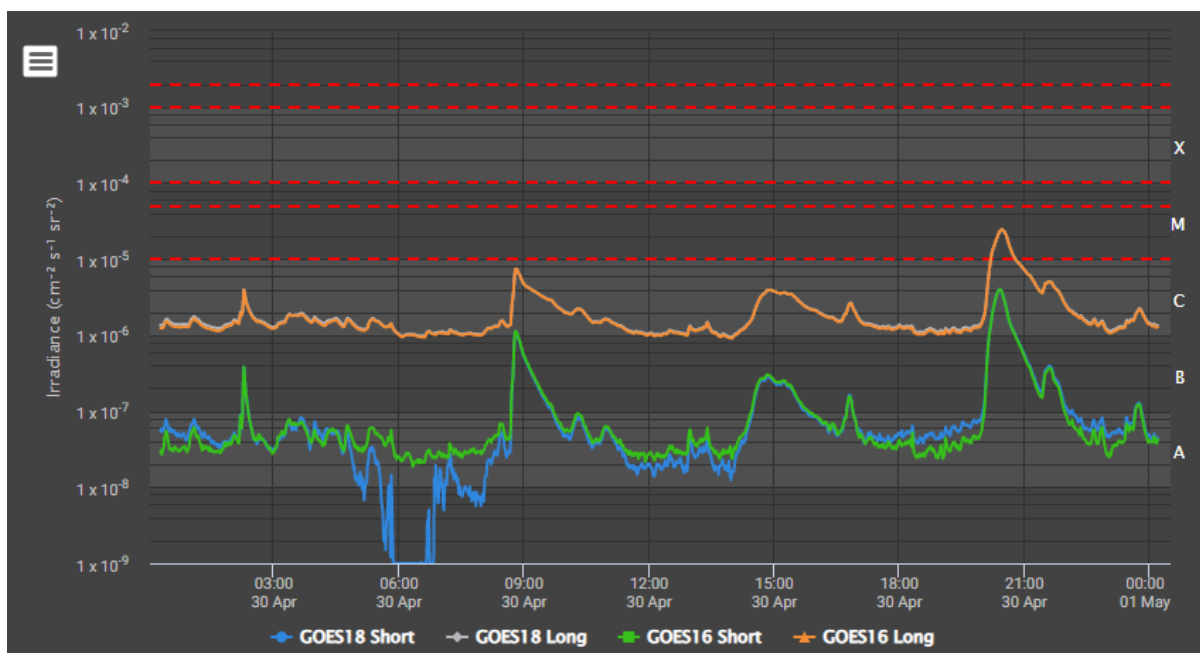
Radio Blackouts - X-Ray Flares:

Moderate to Low activity is expected with an ongoing chance of M-flares (R1-R2 Radio Blackouts). Of the six sunspot regions on the disc, three of them are currently considered the most likely source regions of any notable flaring.

The first of these is AR3288 in the southwest. This is a wide region consisting of a number of spots with strong umbra and symmetric penumbra, including two clear albeit small delta spots. This has also moved close to AR3285, a large but simple spot to its northwest that further complicates the magnetic looping of this region. The second is AR3289, just east of the north-central disc, and is a compact and small region consisting of four separate penumbra areas each with small umbra. This did have a small delta spot, which it has now lost, but due to its compact structure will need to be monitored for further development. The third is a new region that has emerged onto the disc from over the northeast limb, and was the source of the most recent M-flare. This is currently difficult to assess, but is likely to reveal more complexity as it rotates into a less oblique viewing angle.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	55	50	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16/18 X-ray flux



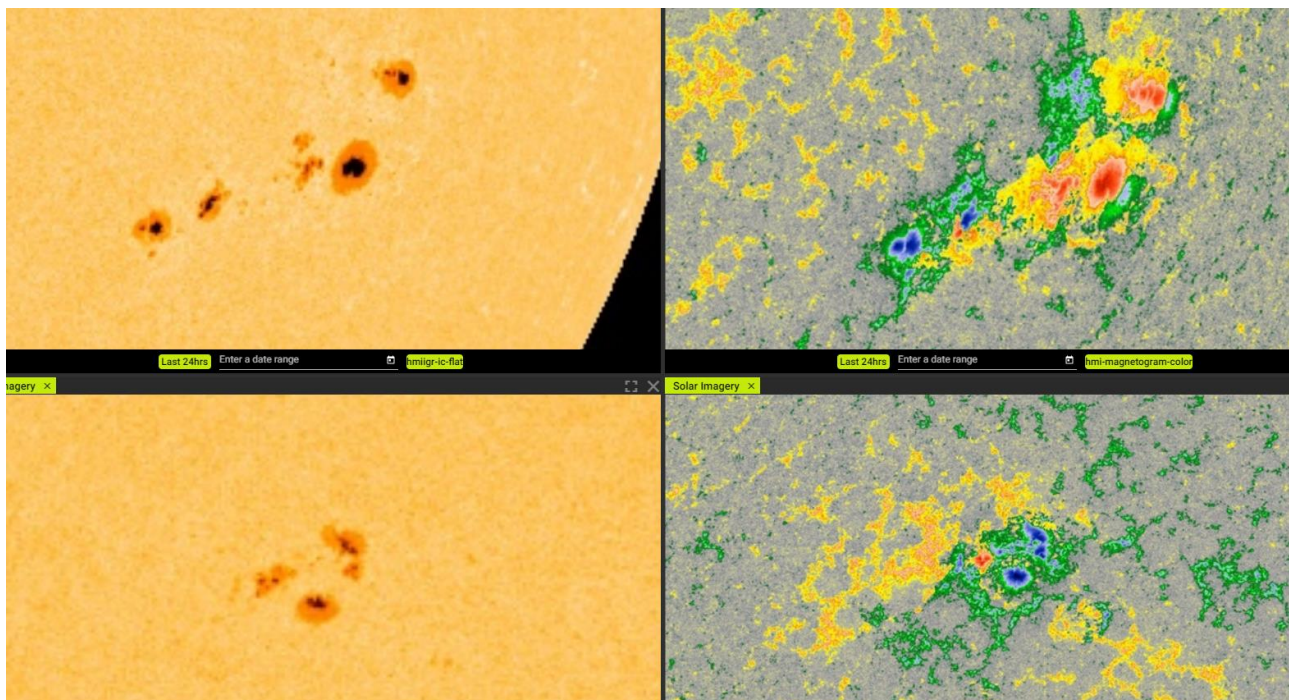
Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux as observed by GOES-16 is forecast to remain at background, with no solar radiation storms expected. Any significant flares, primarily from AR3288, have the potential to increase the observed flux towards the S1 Minor radiation storm threshold, with a very slight chance of exceeding.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	5	5	5	5
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

Figure 4: SDO hmi-intensitygram and magnetogram of AR3288 and AR3285 (top) and AR3289 (bottom)



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy (greater than 2MeV) electron flux as observed by GOES-16 at GEO is expected to continue at mainly High through days 1 and 2 (01 and 02 May), albeit with a declining trend. Confidence falls by the end of day 2 due to the low chance of CME arrivals, which have the potential to drop out the observed flux if they occur. However, these are currently expected to miss, with mainly High levels continuing. By day 3 and 4 (03 and 04 May) more prolonged periods of Moderate to Background flux are likely, mainly during the diurnal minimum period, with peak flux gradually declining.

Electron fluence is currently above the Active ($1\text{e}8$ integrated pfu) threshold and is likely to stay that way through the period, but with an erratically decreasing trend, Confidence reduces day 3 onward, due to uncertainties about how quickly peak flux values will decay, along with the potential for any CME arrivals resulting in flux dropping out REFM supports a declining trend, however this is currently considered likely too rapid with its decline.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	100	95	70	60
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: GOES-16 Electron Flux and Fluence with REFM

